S'COOL BREEZE
Student's Cloud Observations On-Line
Volume 1, Issue 10 September 2000

S'COOL Teachers Examine Strategies

S'COOL teachers from three states gathered at Langley Research Center, in Hampton, Virginia, for a workshop from August 31 – July 4. The following participants attended the 5 day workshop:

- Patricia Andre, Toano Middle School, Toano, Virginia
- Leon Blue, Emily Spong Elementary School, Portsmouth, Virginia
- Joseph Carriere, Avery Middle School, Newland, North Carolina
- Janet Carson, Spaugh Middle School, Charlotte, North Carolina
- Selena Hankins Chamblee, Berkeley Middle School, Williamsburg, Virginia
- Barbara Ann Davis, McIver Elementary School, Littleton, North Carolina
- Beverly E. Fairley, Emily Spong Elementary School, Portsmouth, Virginia
- Tina Hankins-Turner and Benson Rutledge, Kiln Creek Elementary School, Newport News, Virginia
- Wanda Hurley, Phelps Elementary School, Phelps, Kentucky
- Cindy Lewandowski, William Natcher School, Bowling Green, Kentucky

INSIDE THIS ISSUE

How CERES Catches Rays

by Kory Priestley, research scientist for the Radiation and Aerosols Branch, Langley Research Center, Hampton, VA.

One of the major goals of the CERES instrument is to measure the amount of clouds in the atmosphere and their impact on the Earth's radiative energy balance. Since clouds reflect the sun's energy back to space, they have an overall cooling effect on the planet. However, since cloud formation is a possible natural reaction to reduce global warming caused by the greenhouse effect it is very important to accurately measure the amount of clouds and their properties. How does the CERES instrument accomplish this goal?

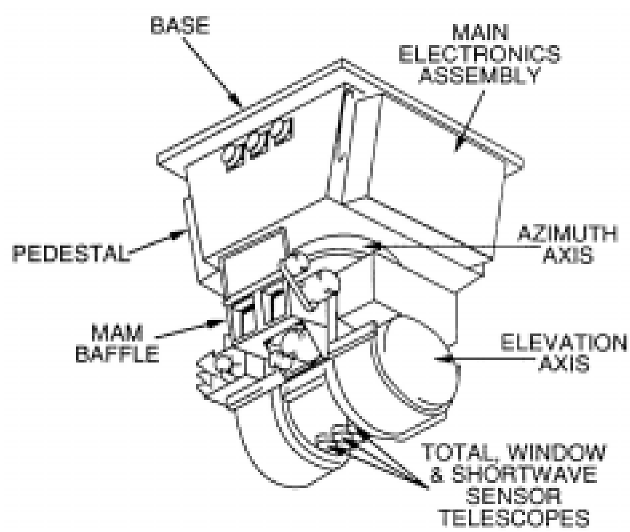

Figure 1: The CERES instrument package contains 3 telescopes and will fit in a cube with 60 cm sides.

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CERES instrument continued

S'COOL Workshop continued page 2

The CERES instrument contains three small telescopes which measure both the earth-reflected sunlight as well as emitted terrestrial thermal energy. Figure 1 is a picture of the CERES instrument. The optical prescription of the telescopes dates back to a design first proposed by a French scientist named G. Cassegrain in 1672. In the Cassegrain telescope, rays of light entering the aperture are reflected first from a large concave primary mirror onto a small convex secondary mirror which focuses the rays near a small opening in the center of the primary mirror. In the center of this opening is a very small precision aperture which defines the field-of-view of the instrument. Behind this small aperture is a detector whose temperature changes according to the amount of energy that enters the telescope. Figure 2 displays a cross-sectional view of a single CERES telescope.

One may think that it would be necessary to build quite a large telescope to measure clouds from a satellite orbiting the Earth at an altitude of 700 km but that is not the case. The mirrors used in the CERES telescopes are round and have diameters of only 1.9 cm for the primary mirror and 0.8 cm for the secondary mirror. For reference, pencils typically have a diameter of approximately 0.8 cm which is the same size as the secondary mirror. The detector has dimensions of 0.3 by 0.15 cm (about the size of a grain of rice) and a thickness of only 0.005 cm, or roughly half the thickness of a sheet of paper. The overall length of the telescope in Figure 2 is 9.2 cm making it small enough to fit in the palm of one's hand. Finally, the detector measures temperature changes as small as 0.000001 Kelvin (i.e. 1 micro Kelvin). Note: T (K) = T(C) + 273.15. To put this in perspective, the difference between the freezing and boiling points of water is 100 K. If we converted a micro Kelvin to a volume, say the size of a standard soccer ball, then the volume of 100 Kelvin would be a regulation world cup soccer field stacked more than 50 meters high with soccer balls. The instrument would be able to tell if a single ball were removed.

Although the CERES instruments are small and extremely sensitive, they are also very rugged and highly dependable. First, the instruments must be able to survive the rough ride into orbit onboard the rocket. To ensure survivability the instruments are subjected to a series of shaking tests where loads of up to 17 times the force of gravity are applied. To a human this is analogous to 17 of your friends sitting on top of you. On-orbit dependability is critical. Consider that the instrument must function properly for more than 5 years with no opportunity for maintenance or repair. This is analogous to not being able to clean your eyeglasses for 5 years, or not changing the oil in your car for over 3.5 million kilometers.

As you can see the design and fabrication of space based instruments is a very difficult job. TRW, the company which designed and built the CERES instruments, has done an outstanding job and deserves many thanks from the scientists and educators who are able to use CERES data to monitor the health of our planet.

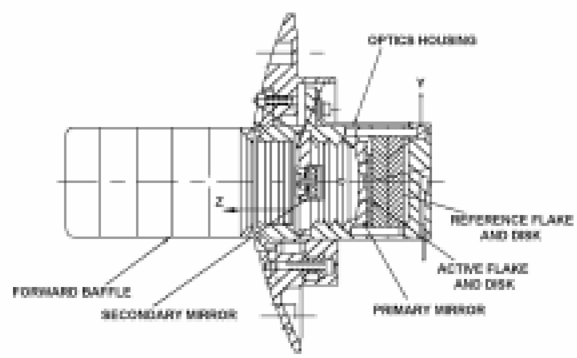

Figure 2: An individual CERES telescope.

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S'COOL Workshop continued from page 1

- Nancy Linsangan, Windsor High School, Windsor, Virginia
- Gary Major and Debbie Turner, Aurelian Springs Elementary School, Littleton, North Carolina
- Ken Mattingly, Rockcastle County Middle School, Mt. Vernon, Kentucky
- Pat Owen, G-STAT-Langston Focus Center, Danville, Virginia
- Janet Petersen, I.C. Norcum High School, Newport News, Virginia
- Linda Shelton, Northwest Cabarrus Middle School, Concord, North Carolina

See insert for pictures and report from workshop.

S'COOL HITS 500 IN JUNE WITH THE ENROLLMENT OF RAMSTEIN AMERICAN SCHOOL

RAMSTEIN, GERMANY

S'COOL NOW HAS 578 SITES ENROLLED IN 43 COUNTRIES

TRY THIS

INVESTIGATION: FIRST AIR SOUP, THEN PIE

Nitrogen makes up 78 percent of Earth's air. Oxygen makes up 21 percent. The remaining 1 percent is carbon dioxide, argon, water vapor, and the **trace gases** – those that exist in very small amounts, or traces. ATLAS instruments precisely measured many of these rare but important gases.

These percentages and others are easier to understand if shown on a pie chart. Remember that a circle contains 360 degrees

Materials Needed:

- White construction paper
- Protractor and pencil

Procedure

To construct a pie chart, calculate 78 percent of 360 degrees. This is the number of degrees that will be in the **nitrogen** piece of the pie chart.

- Decimals: 0.78 x 360 = _____ round answer to nearest unit = ____
- Fractions: 78/100 x 360 = _____
- **Oxygen**: Decimals: 0.21 x 360 = ___ Rounded = ____
- Fractions: ______ x 360 = ______
- **Trace gases, carbon dioxide, water vapor, argon**: Decimals: ___ x 360 = ___ Rounded = ____
- _____: 1/100 x 360 = _____
- With a compass, construct a circle with a radius of about 5 cm. Use a protractor to mark the sizes of the angles and construct your pie chart. Be sure to label the various pieces of the atmospheric pie.

Relating Science to:

Photography:

Take color photographs or find pictures of a distant mountain or skyscraper on a clear day and a hazy day. Compare the two images. Notice that the colors on a hazy day are different. The mountain may be more blue than green.

What is in the atmosphere on a hazy day that would change the colors?

Helping Planet Earth

If you use products such as paint, hair spray, or deodorant that are packaged in aerosol cans, be sure to dispose of them safely. If you avoid puncturing the cans, you will help keep chemicals from entering the atmosphere.

(Taken from NASA's "Earth's Mysterious Atmosphere"

Comments from all over

Comment from a student of teacher Laurel Fais, Kyoto International School, Kyoto, Japan, "We learned the names of the clouds….and what the names mean. I find that I even look at the clouds carefully on the weekends." Ms. Fais adds, "It has been a meaningful learning experience for my class."

From W.C. K. Walls School, in Pitman, New Jersey, USA , teacher Candice Ware writes, "I feel that this was a very worthwhile project for my children and they learned a lot from doing it."

News Bulletin

Teachers, please let us know if your email or postal address changed over the summer.

S'COOL was presented at the International Geoscience and Remote Sensing Symposium conference in Honolulu Hawaii in July, 2000.

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Upcoming events

S'COOL Presentations at conferences for NSTA in Milwaukee Wisconsin, Baltimore Maryland, Phoenix Arizona, Maryland State Teachers Association in Ocean City Maryland and Virginia Association of Science Teachers in Roanoke Virginia

Aqua Launch, 2000

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